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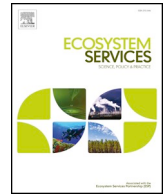
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He says, she says: Ecosystem services and gender among indigenous communities in the Colombian Amazon

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ABSTRACT

Although it has been hypothesized that men and women vary in the way they value ecosystem services, research on ecosystem services rarely incorporates a gender dimension. We conducted research with nine indigenous communities in the Colombian Amazon to understand which ecosystem services men and women perceive as most important for their wellbeing and to rank them according to locally-defined criteria of importance. Participants identified a total of 26 ecosystem services and 20 different ranking criteria. Ecosystem services such as land for agricultural fields (a supporting service), and provision of fish and medicinal plants were equally important for both men and women. Wild fruits and resources to make handicrafts were more frequently mentioned by women, whereas timber, materials for making tools and coca leaves were more frequently mentioned by men. There were also differences in the criteria used to value ecosystem services, with 11 criteria mentioned by both men and women, five mentioned exclusively by women and another four only by men. Our results suggest that taking gender differences into account in ecosystem services assessments may result in the prioritization of different services in conservation and sustainable development programs, and may lead to different outcomes for ecosystem service provision and local livelihoods.

1. Introduction

The abundant literature on ‘ecosystem services’ (ES) that has been published since the appearance of the Millennium Ecosystem Assessment in 2005 has generally ignored a gender dimension (Brown and Fortnam, 2018; Daw et al., 2011; Yang et al., 2018). For instance, recent systematic reviews of the literature on ES and wellbeing (Cruz-García et al., 2017) and on ES and food security (Cruz-García et al., 2016) in Latin America, Asia and Africa reported that less than 10% of published case studies incorporated a gender approach. While it has been hypothesized that men and women vary in the way they value ES, to date, few ES assessments have taken gender dimensions into account.

Gender is an important mediator of how humans view and interact with their environment. It often influences the use, knowledge, management, access and control over environmental resources (Rocheleau and Edmunds, 1997; Sunderland et al., 2014). There is substantial evidence highlighting gender differences in local ecological knowledge (e.g., Dovie et al., 2008). Gender differences have also been explained in relation to the use of natural resources (e.g., Meinzen-Dick et al., 1997; Westermann et al., 2005), including non-timber forest products (e.g., Ingram et al., 2014; Paumgarten and Shackleton, 2011) and community forestry (e.g., Agarwal, 2001; Mai et al., 2011). As emphasized by Leach et al. (2016), consideration of gender differences and relations is integral to achieving sustainable development and avoiding

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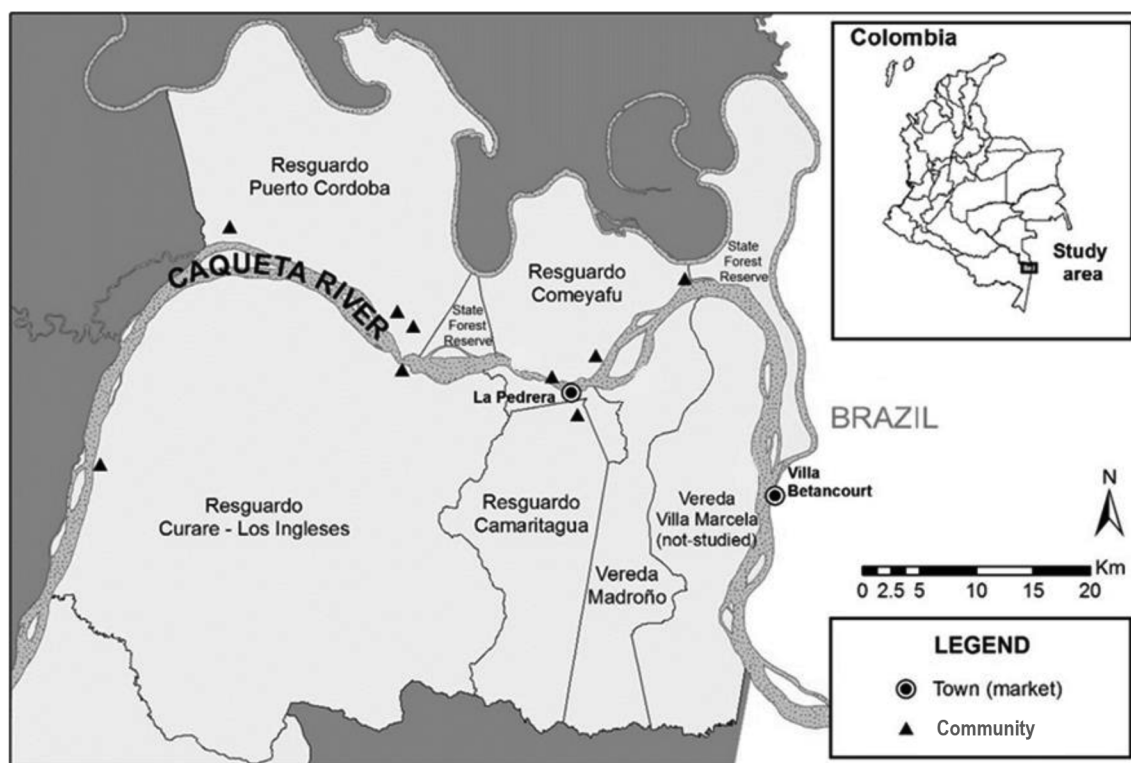


Fig. 1. La Pedrera *corregimiento*, Colombia, indicating the location of the nine communities that took part in the study.

the costs of environmental and economic change that undermine gender capabilities and the sustainability of communities. Past gender research has established that there is a need to include women as part of conservation and development initiatives, decision-making and formal environmental governance, given that different social groups have diverse ways in which they relate to, and interact, with the environment (Arora-Jonsson, 2014). Women and men may have different knowledge, perceptions and preferences for environmental conservation, and these may influence which conservation and development options are most appropriate for a given site (e.g. Rao et al., 2003). Although more than forty years of gender research has positioned gender as a category that has to be included in environmental policy making, it has had little influence on environmental practice (Arora-Jonsson, 2014; Ravera et al., 2016).

Ecosystem services research, assessments and valuation have yet to incorporate useful theories and methodologies from the field of gender and the environment. This can have major implications for ES conservation and community wellbeing. For instance, consideration of gender roles related to ES can reveal differences in men's and women's knowledge, valuation, use of and access to ES, within multiple social dimensions of power. Failing to consider gender may lead to conservation initiatives and development interventions that do not meet the interests of both men and women, or reflect their respective views in the negotiation of trade-offs between different ES. By not providing accurate information to policy and decision makers, such initiatives, interventions and negotiations may inadvertently reinforce prevailing power differences (i.e. strengthening the power of certain groups and diminishing the power of those whose views are excluded from the studies). It is particularly necessary to incorporate a gender approach in social contexts where the views and perspectives of women are frequently neglected, and within an ES framework that often overlooks issues of power imbalance (Fisher et al., 2013).

Recent studies (e.g., Calvet-Mir et al. 2016) have emphasized that gender should be a transversal component of all processes of ES assessment and valuation. Indeed, there is a need to examine how gender

influences the identification and perceived value of a range of ES. This is particularly important in the Amazon, a region inhabited by diverse indigenous populations who are highly dependent on locally sourced ES for their livelihoods. Although the Amazon basin is one of the most biodiverse regions on the planet, it is home to a high concentration of vulnerable populations both in terms of environmental dependence and poverty (Celentano and Vedoveto, 2011). Among indigenous communities, women are the most affected by poverty and discrimination, as reflected in lower educational attainments, reduced labor opportunities (United Nations, 2006) and high rates of maternal mortality (Celentano and Vedoveto, 2011). A gendered analysis that compares the preferences of indigenous men and women for different types of ES in the Amazon could provide useful insights for the design of conservation and development projects so that they contribute to the wellbeing of all. However, ES valuation studies that have been conducted in the Amazon do not usually consider gender (e.g. Lead et al., 2010; Tallis and Polasky, 2009).

The objective of our study was to compare how indigenous men and women prioritize ES and the criteria they use to assess the importance of ES for their wellbeing. Based on the results, we seek to provide recommendations on how to incorporate gender differences in the use or valuation of ES into conservation and development plans. We conducted research with nine multi-ethnic indigenous communities in La Pedrera, located in the Colombian Amazon. Our research provides the foundation for a gender approach to ES valuation and priority setting aimed at contributing to Sustainable Development Goal (SDG) number five "Achieve gender equality and empower all women and girls" and SDG 15 "Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss" (United Nations, 2015). Our study illustrates the need to address both goals synergistically to ensure the sustainable management of ecosystems and secure community wellbeing by incorporating the perspectives of both men and women. In particular, SDG Target 15.9 requires that ecosystem and biodiversity values are integrated into "national and local planning, development processes, poverty reduction strategies and accounts", and

serves as a major imperative for ensuring ecosystem service valuations do not overlook vulnerable populations, including women. This case study provides a methodology for incorporating the gender dimension into ES research and assessments that could be helpful for researchers and practitioners working with indigenous and local communities in other forested areas who want to better incorporate ES into their conservation and sustainable development initiatives.

2. Research site

The research was conducted in nine indigenous multi-ethnic communities that are part of four different Indigenous Reserves in the *corregimiento* of La Pedrera (a *corregimiento* is an administrative unit smaller than a municipality), located in the Northeast of the department of Amazonas in Colombia (Fig. 1). The territory of an Indigenous Reserve is collectively owned and indigenous groups are autonomous in the management and administration of the natural resources (Departamento Nacional de Planeación, 2010). The region is characterized by high forest cover, marginal deforestation rates, limited market integration, and livelihoods that are strongly dependent on ES (Fontaine, 2008; Ramirez-Gomez et al., 2015). Communities in La Pedrera are river-bank dwellers situated along the lower reaches of the Caquetá River.

The Colombian Amazon is characterized by the presence of tropical lowland and upland rain forest. The annual rainfall fluctuates from 2500 to 4250 mm, and the average annual temperature oscillates between 25 and 28 °C (Chaparro, 2007). There are two major periods in the year affecting local subsistence activities in La Pedrera, i.e., when the river water level rises from May to July (locally called *creciente*) flooding many agricultural areas, and when it decreases from August to April (*vaciente*).

The results of a household census conducted in 2014 by the 'Attaining Sustainable Services from Ecosystems using Trade-off Scenarios' (ASSETS) project, which included an estimated 90% of all households in the region, indicated that the study site in La Pedrera had a total population of 879 inhabitants, 54% males and 46% females. The indigenous communities were patriarchal, with 90% of the households being male-headed. The women heading the remaining 10% of households were mainly widows or divorcees. Fourteen percent of men and 23% of women older than 15 years were illiterate. Communities ranged in size from six to 33 households and the mean household size was 5.5 persons. Each family cultivated an average area of 1.4 ha in *chagras* (ASSETS, unpublished data). From the perspective of indigenous communities in the Colombian Amazon, a *chagra* is not only the agricultural field (based on swidden agriculture), but also a traditional space of communication, learning and sharing for the family (Muñoz et al., 2011). Most communities have a primary school, but there is only one secondary school in the area, located in La Pedrera town (Martínez, 2011). Communities generally lack access to electricity and sanitation.

3. Methods

3.1. Data collection

This study relies on the definition of gender of the Cooperative for Assistance and Relief Everywhere (CARE International Gender Network, 2012: 2) as a social construct that "defines what it means to be a man or woman, boy or girl in a given society – it carries specific roles, status and expectations within households, communities and cultures". Within this definition, this study specifically addresses men's and women's roles and perceptions with respect to the prioritization and criteria of ES importance. Sex-based comparisons (i.e., based on a biological condition) are used as indicators of a gender construction.

We collected data through focus group discussion exercises in nine communities between March and June 2013. We used participatory research methods both because they are considered particularly

appropriate for analyzing how different social groups prioritize and value different ecosystem services (Poppy et al., 2014), and because they can be used in a less extractive manner that explicitly values local knowledge. The indigenous authorities from the participating communities and the association of indigenous authorities in La Pedrera (AIEPA, Asociación de Autoridades Indígenas de La Pedrera Amazonas) were informed and consulted for approval before conducting the study. They, together with the communities, defined the dates on which field work took place, and were provided a schedule of the activities. All persons who participated in the study did so freely and with prior informed consent, and all exercises were tape-recorded with the permission of the informants. The study obtained ethics approval from the University of Southampton's Ethics Committee (Ref 8717). Participatory exercises were piloted in an indigenous *Huitoto* community in Leticia district. The purpose of the pilot study was to adjust the methodological tools to the local social, cultural and environmental context. After the pilot study, a few modifications were made (mainly on the wording of questions), but the structure and content of the exercises remained the same. The pilot data were not included in this study.

Prior to the fieldwork, one of the authors (GCG) undertook a scoping visit to the field site. The fieldwork was then undertaken by four field researchers – one man and three women – who were trained in the pilot village by CTV, who, together with GCG, provided frequent long-distance supervision while the team were in the communities. The field team were introduced to the study communities by a research collaborator with 15 years' experience of working in the La Pedrera area. Although Colombian, the field researchers were not indigenous. The week they spent living in each study community was therefore very important for building trust and rapport with community members. Following the research, the results were presented back to the communities in various formats previously agreed with local people. These included oral presentations at a workshop at which results were discussed and validated, posters co-designed with workshop participants and detailed written reports for each community.

The field researchers visited and conducted exercises separately in four of the communities. The other five were clustered into two groups, with each group comprising communities that belonged to the same Indigenous Reserve, had similar livelihoods and shared access to the forest. We conducted two different types of focus group exercises: (1) a household diagram exercise to provide an overview of the main gender-productive roles in the region, and (2) a matrix scoring exercise to examine differences in how men and women prioritize ES, and the criteria they use to assess the importance of ES for their wellbeing. Each exercise lasted from 2 to 3 hours and involved an average of five participants. Focus group participants were selected using purposive sampling which is a nonprobability sample where informants are selected based on expert knowledge of the population and are assumed to be representative of the larger population or a particular social group (Bauer and Gaskell, 2000; Chambers, 2008). For the first exercise, given that we expected livelihood strategies to differ across socio-economic groups, we conducted two parallel focus group discussions in each community, one with better-off and another with worse-off community members. Better-off and worse-off socio-economic groups were locally defined based on landholding areas, health and age of family members, and access to cash income.¹ These focus groups had a mixed

¹ The criteria used to define better-off and worse-off socio-economic groups – i.e. landholding areas, health and age of family members and access to cash income – alongside their respective ranges, were locally delineated during a focus group exercise conducted with community members. In this exercise, mixed groups of men and women from different ethnic groups and residing in different parts of the community, established a list of (non)economic indicators that characterized different local socioeconomic groups and described the village's socioeconomic composition (see exercise D in Schreckenberg et al., 2016). The families belonging to each socio-economic group were defined in another focus group exercise, i.e. wellbeing ranking, where a pile of cards with

Table 1

A summary of the number of persons per community that participated in the focus group exercises.

Indigenous Reserve	Community	Household system diagram		Matrix scoring exercise	
		Better off group	Worse off group	Women only	Men only
Curare Los Ingleses	Borikada	5	5	4	4
	Curare (Los Ingleses)	6	5	7	6
Puerto Cordoba Comeyafú	Puerto Córdoba, Loma Linda and Bocas del Mirití ¹	5	4	4	6
	Bakuri	4	5	4	4
	Comeyafu Yucuna and Comeyafú Tanimuca ¹	6	7	5	7
Camaritagua	Camaritagua	5	–	6	4
Total		31	26	30	31

¹ Clusters of communities.

participation of men and women. For the second exercise, we conducted two separate focus group discussions in each community, one with men and another with women. We structured this set of focus groups with the expert advice of local leaders to ensure not only representation of different sexes, but also from residents of different ages and locations within the community.

A total of 11 household system diagram exercises (six with better-off and five with worse-off community groups) were completed, with a total of 57 participants (Table 1). In this exercise (described as exercise F in Schreckenberg et al., 2016), informants were guided by the facilitator to describe local livelihood strategies and gender roles in the different parts of the landscape used by the family, including *chagras*, home gardens, forests, fallows and rivers. Informants were first asked to draw the household in the center of a large sheet of paper, together with the different landscape components. They were then asked to indicate the main household supplies, crops and wild products, as well as their sources; and to use arrows to link these supplies to the different parts of the landscape where they were obtained. During the exercise informants were asked if men, women, or both, were responsible for different household productive activities. Although both men and women actively participated in the focus groups, having mixed groups might have influenced the way men and women discussed gender roles and may thus have affected the results. However, we were able to corroborate much of the information obtained from the household diagram exercises with information obtained through other exercises that are not reported here, including transect walks, participatory mapping of land use and specifically of wild food sources, focus groups on wellbeing and livelihoods, and focus groups on foods and food sources (some of which were carried out separately with men and women).

Twelve matrix scoring exercises (described as exercise W in Schreckenberg et al., 2016) were conducted in total (six with men and six with women), constituting a total of 31 men and 30 women. Where possible, a male researcher facilitated the discussions with men and a female researcher facilitated discussions with women. The facilitators began the exercise by introducing ES as ‘the benefits from the surrounding environment that allow participants to survive and to carry out their subsistence activities’. Facilitators and participants discussed this proposed definition to clarify its meaning and express it in locally appropriate terms. Following agreement on the concept, the participants were asked to make a list of ES in the community. We are aware that this working definition – which our pilot community experience showed was the easiest way to explain the concept of ES to indigenous communities – might have biased the answers towards provisioning services. After reviewing the list, participants were asked to identify the criteria that they use to decide which services are most important for

their wellbeing. Participants then selected the most important ES for their wellbeing (up to a maximum of 15) and developed a matrix in which they gave a score from zero to ten (where zero is the lowest, ten is the highest) to each ES with respect to each locally defined criterion of importance. When a particular criterion was not applicable for a specific ES type, the ES type was not scored for this criterion. For example, the ES ‘hardwood’ was not scored in relation to the criterion ‘diversity of dishes’ as local communities highlighted that this combination was not applicable.

3.2. Data analysis

Data on gender productive roles was extracted from the household diagram exercises using hand-written notes and audios from the participatory exercises and comparing the texts of the nine focus group discussions. Matrix scoring exercises were transcribed to make sure that the lists of ES and criteria of importance included those mentioned by the informants (and were not prompted by enumerators).

Women’s and men’s lists of ES and criteria of importance were analyzed using quantitative content analysis. To facilitate the analysis, the ES listed by local communities were coded/grouped into mutually exclusive ES types, corresponding to different ES categories (following TEEB, 2015). Likewise, criteria of importance were also grouped into mutually exclusive thematic groups (with no overlapping criteria). The results from the matrix scoring were analyzed by calculating the frequency of mention, highest and lowest values (maximum and minimum), medians and modes for each thematic criteria group per ES type across focus groups, with separate calculations for women and men. If two or more criteria of importance belonging to the same thematic group were listed for a particular ES type in the same focus group, all scores were included in the analysis, correspondingly. When an ES type was not scored with respect to a particular criterion, because it was not applicable according to the informants, this particular combination was not included in the analysis. Wilcoxon’s non-parametric equality of medians for non-related samples was applied to test the statistical significance of the differences between men’s and women’s scores given to all ES in relation to criteria of importance (Maechler, 2016). All analyses were done in R version 3.5.0. Only probability values below or equal to 0.05 were considered statistically significant. Results that reached the 0.10 level of probability were reported as marginally significant differences in order to indicate a trend.

4. Results

4.1. Main productive activities and gender productive roles

The participants reported that their main productive activities were hunting, fishing, farming and gathering of wild fruits. In addition, informants also collected firewood and water for domestic use, medicinal plants, construction materials (e.g., timber and thatch) for building houses and boats, and raw materials for crafting tools for domestic use,

(footnote continued)

the households’ names was evaluated by focus group participants in relation to the criteria listed in the previous exercise (see exercise E in Schreckenberg et al., 2016).

Table 2

Main gender productive roles in the study site (from 11 focus groups with a total of 57 participants, including men and women). An activity is shown as being conducted only by women or only by men when this was reported in all focus groups; an activity is shown as being carried out by both when focus groups either differed in their answers or when they indicated that both conducted the activity.

Productive activity	Men	Women
Fishing (and commercializing fish)	X	
Hunting in the forest (and commercializing bush meat)	X	
Collecting building materials for building houses and boats	X	
Collecting raw materials and crafting (weaving baskets, making wood handicrafts and cultural items, making tools for hunting and gathering)	X	
Gathering medicinal plants in the forest	X	
Farming coca and making <i>mambe</i> [‡]	X	
Slashing and burning for making a new <i>chagra</i>	X	
Planting crops in the <i>chagra</i>	X	X
Maintaining the <i>chagra</i> ^α	X	X
Harvesting products from the <i>chagra</i>	X	X
Collecting firewood	X	X
Gathering medicinal plants in the home garden or agricultural field	X	X
Gathering wild fruits	X	X
Collecting water		X
Preparing and processing food		X

[‡] *Mambe* is a powder that is chewed by men, prepared with roasted coca leaves (*Erythroxylum coca* Lam) and ashes of *yarumo* (*Cecropia* sp.) leaves that are added to activate the alkaloids.

^α This mainly refers to weeding and taking care of the crops.

cultural activities, and productive activities. They obtained ES from the surrounding landscape mosaic that includes forests, water bodies, *chagras*, fallow fields or areas of secondary vegetation arising in abandoned *chagras* (*rastrojos*), home gardens (*patios*) and *salados* (areas within the forest with a high concentration of salt). *Salados*, which were usually regarded as sacred sites, were particularly important for hunting because the high salt levels attract game. There were different types of *chagras*, for example, *chagra de monte* is the field created from the forest, *chagra de rastrojo* is the field created from a fallow field, *chagra de orilla* is the area on the river bank that is used for agriculture in the dry season when it is not flooded, and *chagra de isla* is the area of land within the river that only emerges when the water level decreases and is very productive for agriculture. According to informants, *chagras* were assigned by traditional authorities to families when they become community members.

The gender productive roles related to these activities are detailed in Table 2. From a total of 15 productive activities, seven were exclusively conducted by men, two by women and six by both.

4.2. Gender differences in frequency of mention of ES

The focus group participants from indigenous communities in La Pedrera listed a total of 26 ES that they received from the surrounding landscape, including 19 provisioning, five regulating and two supporting services. Focus groups mentioned an average of ten different ES (range = 5–15). There was no substantial difference in the mean number of ES mentioned by men (12) and women (11). A total of 20 ES were mentioned by both men and women, including the provision of bush meat, fish (from ravines, river and water bodies), products from *chagras*, wild fruits, water (from water bodies), firewood, hardwood (for building own houses and for selling), *puy* leaves (*Lepidocaryum tenue*), materials for household tools, materials for cultural activities, medicinal plants, coca, air quality, maintenance of soil fertility, and land for *chagras* (from the forest, fallow fields and river banks). Three ES were mentioned exclusively by women (provision of *charapa* (*Podocnemis*

expansa), building materials, soil types); and another three exclusively by men (provision of fruits from home gardens, water from rain, land for *chagras* (from *islas*)) (Table 3). Different focus groups varied in the specificity they gave to some types of ES. For example, while some listed ‘inputs for building’ (which included hardwood, *puy* leaves for roofing and fibers for building houses), others specified hardwood for building houses, hardwood for selling, and *puy* leaves as separate ES. The 26 ES listed by local communities were grouped into 15 mutually exclusive ES types (Table 3). These services were related to various household activities including hunting, fishing, gathering, farming, crafting and collecting raw materials.

The most frequently mentioned ES – including provision of fish, firewood, building materials, wild fruits, bush meat, medicinal plants and materials for household tools, water and land for agricultural fields – were similar for men and women (Table 3). In contrast, the provision of materials for cultural activities was more frequently mentioned by women than by men, whereas the provision of coca leaves was more frequently mentioned by men.

4.3. Gender differences in criteria used to assess ES importance

Representatives from local communities in La Pedrera listed a total of 20 different criteria for scoring the importance of different ES. Both men and women listed an average of seven criteria per focus group. Eleven criteria of ES importance were mentioned by both men and women, whereas five were mentioned exclusively by women and another four only by men. The 20 criteria listed by informants were grouped into 14 mutually exclusive thematic groups (Table 4).

The frequency of mention of some criteria differed between genders (Table 4). Men frequently mentioned availability and accessibility as key criteria. Conversely, the contribution of ES to health and income generation were more commonly mentioned by women. Both men and women emphasized the importance of ES as food and support for having food.

It might be surprising from the results of the previous section that informants did not list any cultural ES (although raw materials for cultural activities were mentioned by several focus groups). However, cultural importance – as a criterion – was attributed to all provisioning, regulating and supporting ES listed by men and women.

4.4. Gender differences regarding criteria of importance for each type of ES

There were no statistically significant differences between men’s and women’s scores regarding the importance given to each type of ES, with the exception of wild fruits (Wilcoxon’s $z = 0.05$). Women gave higher scores than men to the cultural importance of wild fruits, their availability, importance for health, value for income generation (household economy), and their use for construction (the wood of some fruit trees is used for construction) (Fig. 2D). Women explained that some wild fruits, particularly palms like *chontaduro* (*Bactris gasipaes* Kunth) and *canangucho* (*Mauritia flexuosa* L.f.), played a central role in their traditional dances, where they were used to prepare *chicha*, a fermented drink. Women from Curare explained that *milpesos* (*Oenocarpus bataua* (Mart.)) was not only eaten as fruit, but also used to extract oil for cooking. Women also explained that they prepared fruit juices and sold them to have an extra income.

In addition, there were marginally significant differences (Wilcoxon’s $z = 0.10$) between men’s and women’s scores given to fish (Fig. 2A) and materials for cultural activities. For instance, women gave higher scores to the availability of fish, its cultural importance and accessibility, whereas men gave higher scores to the importance of fish for construction. The latter referred to the fact that indigenous communities usually build houses using a reciprocal labor system (*minga*) in which the owner of the house offers food (including fish) and drinks to

Table 3
Ecosystem services (ES) listed by representatives of indigenous men and women in La Pedrera, Colombia, grouped according to category and type (from 12 focus groups with a total of 61 participants, including men and women).

ES listed by communities	Description of ES listed by local communities and the ecosystems that provide these services TEEB, 2015 *	ES types (as grouped by the researchers)**	Frequency of mention of ES types in focus groups	
			Men (N = 6 focus groups)	Women (N = 6 focus groups)
Fish (from ravine)	Fish are a major component of the daily diet in the study site. Fish are also commercialized. Local people specified from which type of water body they get fish. This ES refers to fish from ravines.	Provisioning (food)	6	6
Fish (from river)	Fish are obtained from the Caquetá river and river banks.			
Fish (from water bodies)	Fish are obtained from the Caquetá river, river banks and ravines.			
Firewood	Firewood is collected from multiple ecosystems with the main purpose of cooking.	Provisioning (raw materials)	6	6
Hardwood for building own houses	Hardwood is mainly collected in the forest. This category exclusively refers to hardwood for building the houses of the community.	Provisioning (raw materials)	6	5
Hardwood for selling	Hardwood is exclusively collected for sale			
<i>Puy</i> leaves	Leaves of the <i>Lepidocaryum tenue</i> Mart. palm are used for weaving roofs.			
Building materials	Hardwood, <i>puy</i> leaves, fiber and other types of provisioning services are needed for building houses. Sometimes participants also refer to making canoes.	Provisioning (food)	5	6
Fruits from home garden	Fruits from trees and palms, mainly wild, are gathered from home gardens (<i>patios</i>).			
Wild fruits	Wild fruits are gathered from agricultural fields, fallow fields and forests.	Provisioning (food)	5	5
Bush meat	Wild animals are mainly hunted in the forest but can also be found in agricultural fields, fallows and <i>salados</i> (sacred sites within the forest that attract animals for their high concentrations of salt). They are locally consumed and commercialized.			
<i>Charapa</i>	<i>Charapa</i> is a turtle <i>Podocnemis expansa</i> (Schweigger 1812). <i>Charapas</i> are hunted and their eggs are collected mainly from river banks, usually for own consumption.			
Medicinal plants	Medicinal plants are gathered from different ecosystems, including forests and home gardens.	Provisioning (medicinal resources)	5	5
Materials for household tools	Raw materials collected from forests and other ecosystems are used for weaving baskets, making domestic utensils, and tools for productive activities.	Provisioning (raw materials)	4	3
Water (from rain)	Rain water is collected in receptacles for domestic use. It is also the only source of water for the <i>chagras</i> .	Provisioning (fresh water)	4	3
Water (from water bodies)	Water from ravines and rivers is collected in buckets and is mainly for domestic use.			
Land for <i>chagras</i> (from the forest)	This land is obtained after slashing and burning forest areas. According to villagers, produce from this type of <i>chagra</i> is of better quality.	Land for agricultural fields (<i>chagras</i>)	3	3
Land for <i>chagras</i> (from fallow fields)	This land is obtained after slashing and burning fallows (or <i>rastrojos</i>). According to villagers, <i>chagras</i> on former fallows are easier to clear but have lower productivity than <i>chagras</i> cleared from forest.			
Land for <i>chagras</i> (from river banks)	This land is located in areas close to river banks. It is only used during the summer (dry season). In the rainy season river banks are flooded.			
Land for <i>chagras</i> (from <i>islas</i>)	This land is located in small islands (<i>islas</i>) formed in the middle of the river when the water level decreases in the dry season. They are only productive during this period.			
Products from <i>chagras</i>	Products (mainly cassava and plantain) are harvested from agricultural fields. They are mainly for self-consumption, and the surplus is commercialized.	Provisioning (food)	3	2
Coca	Men chew <i>mambe</i> (see definition of <i>mambe</i> in Table 1) when they get together for socializing and during traditional activities. <i>Coca</i> is also used by traditional healers.	Provisioning (medicinal resources)	3	1
Materials for cultural activities	Raw materials collected from the forest or other ecosystems are used for making masks, dresses, musical instruments and other objects used during traditional activities and dances.	Provisioning (raw materials)	1	3
Oxygen	Oxygen refers to 'having pure air', which is related to air quality.	Regulating (air quality)	1	1
Soil fertility	Soil fertility is necessary for farming in agricultural fields.	Regulating (maintenance of soil fertility)	1	1

(continued on next page)

Table 3 (continued)

ES listed by communities	Description of ES listed by local communities and the ecosystems that provide these services	ES categories (according to TEEB, 2015)*	ES types (as grouped by the researchers)**	Frequency of mention of ES types in focus groups	
				Men (N = 6 focus groups)	Women (N = 6 focus groups)
Soil types	Soil types refer to having different types of soils, which support different activities such as farming, crafting and painting. For instance, participants explained the importance of having different soil types for growing different types of crops. Particular soil types are good for making handicrafts, and others for painting materials for cultural activities.	Supporting	Soil types	0	1

* ES categories according to TEEB (2015).

** The ES types used for the analysis of frequency of occurrence explained in this section of the article.

the persons who come to help. As men are responsible for building houses, they consider fish to play an important role in feeding those who help in the construction of a house.

Both men and women gave high scores to firewood (Fig. 2B), the only source of cooking energy in the communities, for preparing food, accessibility, availability throughout the year, and cultural importance. They both scored firewood low as source of income (household economy). Both emphasized the importance of building materials in construction (Fig. 2C). Both men and women gave high scores to bush meat for cultural importance, but gave it low scores for accessibility, arguing that it was becoming scarcer and men had to spend more time in the forest to be successful with hunting (Fig. 2E). All groups gave high scores to the importance of medicinal plants for their availability, culture and health (Fig. 2F). Water was given a high score by both men and women for both food and health (Fig. 2H). Men and women scored materials for household tools (Fig. 2G) and land for agricultural fields (Fig. 2I) highly with respect to cultural importance, and highlighted the role of land for cultivating their food.

5. Discussion and conclusions

5.1. Do men and women prioritize ES differently?

Our case study adds to the growing evidence that ES and benefits are not gender neutral (Brown and Fortnam, 2018; Fisher et al., 2013; Martín-López et al., 2012; Tadesse et al., 2014). The results show that representatives of both indigenous men and women in the Colombian Amazon identify a similar number of ES, value similarly many of the same services, and share some of the criteria for prioritizing ES. However, there are important gender differences, with men and women mentioning different ES, identifying different criteria for valuing ES importance, and ascribing different values to different ES. In addition, men and women may agree that a particular ES is important but disagree on the reasons why it is important. These findings highlight the importance of taking a gender approach to ES valuation and priority setting, as men and women do not identify or value ES identically; and suggest that assessments of ES or projects designed to maintain ES provision need to take these gender differences into account.

Other studies also report that men and women value different ES and use different criteria of importance, but their specific findings do not necessarily mirror ours. For instance, Martín-López et al. (2012) report that in Spain men give a higher relative importance to provisioning services, while women do so for regulating services. A similar division is found in coastal fisheries in Kenya (Brown and Fortnam, 2018). In contrast, in La Pedrera, we found no major differences across genders regarding ES categories, although this may be related to the methodology applied (as mentioned in Section 3.1, the definition of ecosystem services provided to the indigenous communities might have biased the results in favor of provisioning services). Tadesse et al. (2014) document that women in southwestern Ethiopia have greater appreciation for firewood, whereas men privilege construction materials. In our site, while there were no significant differences in how men and women value firewood and construction materials, women emphasized the importance that both ES have for health, in contrast to men. Conversely, research carried out in Limpopo province, South Africa (Anthony and Bellinger, 2007), suggests that women value recreation (as ES type) more than men, a finding that echoes our results (regarding enjoyment, which is a criteria of importance only mentioned by women). These results suggest that the similarities and differences in the way men and women value ES are specific to the context; and also that the criteria used by men and women to value different ES may vary across socio-cultural settings.

The results of our study provide further evidence to support recommendations that gender should be a major component of ES assessments and valuation studies (Brown and Fortnam, 2018; Calvet-Mir et al., 2016; Yang et al., 2018), and gender considerations should be

Table 4
Criteria of ES importance as listed by representatives of indigenous men and women in La Pedrera, Colombia, also indicating groups of related criteria (from 12 focus groups with a total of 61 participants, including men and women).

Criteria listed by communities	Description of the criteria listed by local communities	Criteria group (as grouped by researchers)	Frequency of mention of criteria in focus groups	
			Men (N = 6)	Women (N = 6)
Food and support for having food*	Related to provision of food products only: importance of provisioning ES to be consumed as food by local families Related to provision of food products and support for food production: importance of ES to be consumed as food, and for growing food Related to provision of food products, support for food production and supplies for food preparation: importance of ES to be consumed as food, for growing food, and for the preparation of food Quality of ES to nourish and give physical strength to perform daily tasks Quality of ES to be prepared in different ways for consumption Availability of ES throughout the year Possibility to sell ES to generate an income Possibility to use ES in exchange for other products needed (non-monetary) Acquisition of ES at no cost in monetary terms ('it is for free'), or at very low cost (e.g. when the only monetary cost is to buy the tools needed to get it) Intrinsic cultural importance of ES related to the maintenance of indigenous knowledge, traditions and culture; possibility to use ES as raw materials to craft tools, masks and clothes that are used during culturally important activities (e.g. traditional dances and celebrations) Acquisition of ES with low physical effort Acquisition of ES investing a short period of time Quality of ES that directly and indirectly contribute to health, including those that help to be strong, and cure or prevent diseases Quality of ES to be used for the construction of mainly houses and canoes Quality of ES to contribute directly and indirectly to the overall wellbeing of the families Abundance of ES in the territory, during the season when it is available Quality of ES to promote the natural regeneration of other resources	Food	6	6
Nutrition		Availability	6	3
Diversity of dishes		Household economy	5	6
Availability				
Source of income				
For exchange				
Low cost				
Cultural importance			5	4
Ease to obtain			5	3
Short time effort				
Health		Health	3	5
For construction		Construction	3	3
Wellbeing		Wellbeing	2	1
Abundance		Abundance	1	0
Allows the natural regeneration of other resources		Ecology	1	0
For hosting visitors		Hospitality	1	0
Multiple benefits		Variety	0	3
Variety of products				
For enjoyment		Enjoyment	0	2
For transport		Transport	0	1

* Although local communities called the criterion 'food and support for having food', different focus groups referred to different things. For instance, sometimes they only referred to the importance of providing food products (e.g. fish, bush meat), whereas other groups also referred to importance of support for food production, land for food production (e.g. maintenance of soil fertility and land for agricultural fields) and supplies for preparing food (e.g. firewood and raw materials for making cooking utensils).

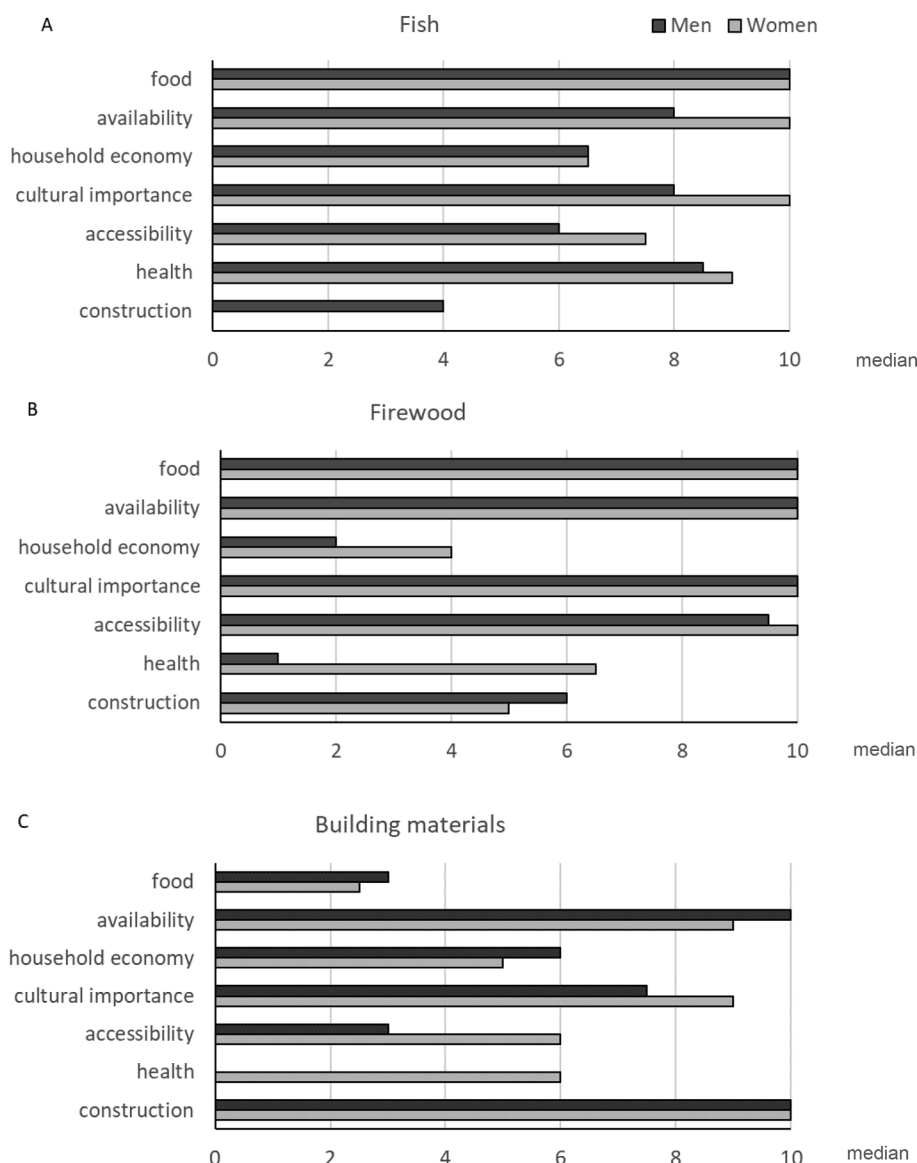


Fig. 2. Median of men's and women's criteria of importance (based on thematic criteria groups) per ES type. Results for ES types and thematic criteria groups that were mentioned in 50% or more of men's and women's focus groups are presented. Scores range from zero to ten, where ten is the highest and zero the lowest. Data represent the median of 12 focus groups with a total of 61 participants, including men and women. A = fish, B = firewood, C = building materials, D = wild fruits, E = bush meat, F = medicinal plants, G = materials for household tools, H = water, and I = land for agricultural fields. Full results are presented in [Appendix 1](#).

included in environmental practice on the ground (Arora-Jonsson, 2014; Ravera et al., 2016). Gender roles are known to influence the collection of forest products around the world (Sunderland et al., 2014). For instance, in our study area wild fruits were mainly gathered and highly valued by women. However, it is also important to recognize that ES are a co-production of natural and social systems, requiring inputs of various capitals (labor, finances, knowledge and education, etc.) to transform ecosystem structures and processes into the final 'benefits' we enjoy (Fisher et al., 2009; Lele et al., 2013; Palomo et al., 2016). Our study emphasizes the importance of paying attention to the gendered nature of the multiple activities involved in deriving benefits from ecosystems. In the La Pedrera communities, fishing and hunting were mainly carried out by men, but the preparation of food was done by women: this means that bush meat and fish as 'food' were co-produced between nature, men (hunters) and women (cooks). This co-

production process appeared to be implicitly recognized by male and female participants who each gave similar scores to fish, bushmeat and firewood in relation to the 'food' criterion. Without delving deeper into such co-production processes, it would be easy for an ES assessment to overlook the gender roles embedded in the different activities that lead to the production of benefits. This could result in valuations which miss the different roles of men and women (for example, in terms of their labor input, skills or power) and thus misjudge who will win and lose (and by how much) from different development interventions, particularly if the production process of ecosystem benefits relies on the marginalization or exploitation of vulnerable populations (Leach et al., 2016).

In the case of indigenous communities, it is particularly necessary to take into account the intersectional nature of gender and power relations, where intersectionality is "the interaction of multiple identities

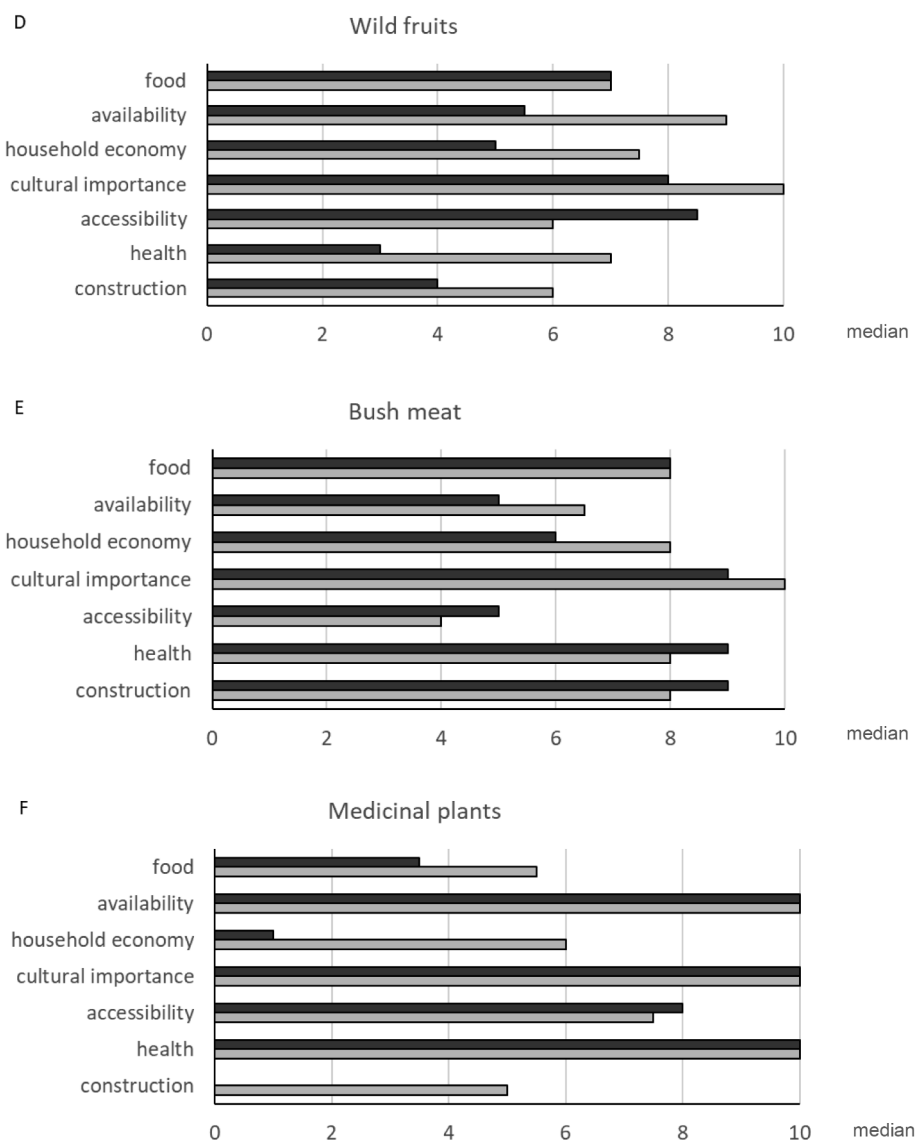


Fig. 2. (continued)

and experiences of exclusion and subordination” (Davis, 2008: 67). For instance, women’s views might often not be heard outside the community because (a) they are women, and (b) they are also from an indigenous group, so they are potentially doubly disadvantaged. Thus, we highlight the need to ensure ES valuations do not overlook vulnerable populations and so perpetuate or worsen their vulnerability by producing a biased valuation and, subsequently, biased policy measures.

5.2. Methodological reflections

There are several methodological caveats to our study which should be considered. First, focus group discussions are particularly useful methods for capturing the everyday use of language and culture of socio-cultural groups, while trying to explore the degree of consensus on a given topic (Morgan and Kreuger, 1993). Focus groups have been

recommended for the assessment of ES priorities and values (Poppy et al., 2014) in a way that is less extractive than household surveys. However, focus groups are not statistically representative samples of the population, so the results cannot be generalized to the study site.

Second, while the researchers tried to ensure that the focus group facilitators built rapport with indigenous communities, and thoroughly understood the cultural, economic and social settings (i.e. facilitators were living in each community while they were conducting the exercises in this particular study, and other exercises corresponding to the broader project), the results might have been different if the facilitators had had an indigenous background. Likewise, it is important to ensure that focus groups with women are facilitated by women and focus groups with men by men, in order to have an optimal accuracy in the results.

Third, this study provided a working definition of ES to the study

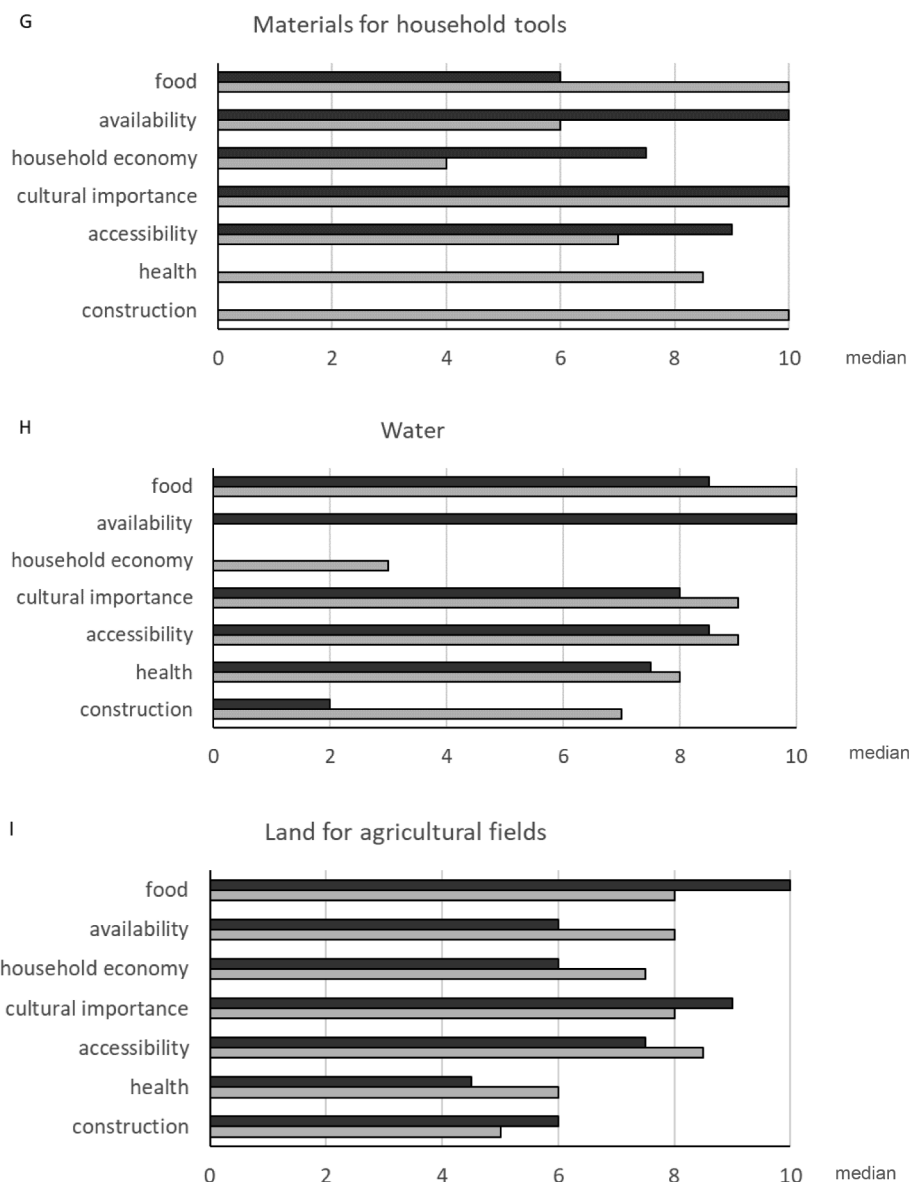


Fig. 2. (continued)

communities, which was previously pilot tested with indigenous peoples in the Amazon. Nonetheless, it is important to highlight that ES – as a term – is not a cultural domain of the studied indigenous communities. For instance, indigenous peoples do not have the word ES within their local languages, they might not think in terms of ‘services’ (but in terms of ‘nature’s gifts’), and they may conceptualize ‘the benefits by the surrounding environment’ differently according to their knowledge systems and ways they interact with nature (Díaz et al., 2015). Although the working definition we used was the most accurate for the study, it might have biased the results towards provisioning services.

A final caveat of our work is that the prioritization of some ES (e.g. provision of bush meat and fish) might be affected by their seasonal availability at the time of data collection. Therefore, we recommend

that future ES valuations compare men’s and women’s prioritizations in different seasons in order to address any potential effect of seasonality on ES identification and prioritization.

5.3. Recommendations for future research

Our study provides novel information – based on focus group discussions with indigenous men and women in the Colombian Amazon – on how they value and prioritize ES. Our study also provides useful insights into how future conservation and development projects could incorporate these gender differences. Future studies could delve deeper into understanding how indigenous communities build gender roles or how their existing gender roles condition the access and use of ES. In

particular, there is a need to understand how these ES-related gender issues support or enhance power differentials between men and women in material and symbolic terms. For instance, with informal rules making fishing and hunting (including the commercialization of fish and bush meat) ‘male’ activities, what are the prospects for single women to live on their own? Certainly, rural women often lack control of or access to land and are therefore discriminated against in terms of using the associated ES (Brown and Fortnam, 2018). In our study site, although there are no formal norms that limit the access of women to administrative positions at any level, it is unusual for women to achieve such positions at either the community or Indigenous Reserve level. Future studies could further investigate how gendered access to land and decision-making influence ES use, prioritization and co-production in La Pedrera and other regions in the Amazon.

The degradation of the natural resource may also affect gender roles differently. For instance, a major problem in La Pedrera is the decline of fish and bushmeat (Ramirez-Gomez et al., 2015). Both fishing and hunting activities are mainly carried out by men. This decline can make men’s roles harder: men have to go farther afield to hunt/fish successfully (Torres-Vitolas et al., unpublished results). Future research might investigate how gender roles – and their influence on ES prioritization – are affected and adjusted in the face of social and environmental change.

Future studies might also explore synergies and trade-offs associated with ES (not only those related to income, land areas or natural resource stocks, but also to lifestyle and domestic roles) from a gender perspective. For instance, what are the potential trade-offs between men and women when conservation projects are designed to favor ES that are valued differently across genders? How can associated negotiations and processes of consensus be managed and developed? It would also be important to assess how – and to what extent – cultural, institutional and political contexts influence the ways in which men and women value ES, and trade-off negotiations take place. Since men and women play different roles, they often face very different cultural, institutional and economic constraints, many of which are rooted in systematic biases and discrimination (Jost et al., 2014).

Finally, in order to have more gender sensitive research on ES, it is necessary to identify which dimensions of gender – in addition to gender roles and prioritization – should be addressed. Based on our wider work in the La Pedrera area (e.g. Ramirez-Gomez et al., 2015; Torres-Vitolas et al., unpublished results), where livelihoods are highly and very directly dependent on natural resources, the gender dimensions of environmental governance deserve particular attention, as well as power relations and rights to land. Furthermore, it might be useful to take an intersectional approach, which captures the diversity of perspectives and views of women within the society. Certainly, it has been widely recognized in the literature on gender and the environment that “different gender identities, associated with other identities, are co-produced through power relations, shaped in everyday life, in a dynamic and negotiation space, explaining different interactions with land, water, trees or other natural resources” (Ravera et al., 2016: S240).

Appendix

5.4. Conclusions

Our study suggests that there is a need to incorporate a gender-based analysis in the assessment and valuation of ES in both conservation and sustainable development projects that aim to ensure the continued provision of these services over time. Applying a gender lens to ES research would help us to understand which ES men and women depend on, which services they value and which services contribute to their wellbeing. In some cases, these services will be similar across genders and projects can be developed to focus on those services that are most important to the overall wellbeing of the whole community. But in cases where there are gender-specific differences, knowing how men and women depend and value different services will allow projects to better target their interventions to promote the wellbeing of all. For example, in the La Pedrera landscape, efforts to promote wellbeing of women could include improving the commercialization channels for locally-made fruit juice, while efforts to promote the wellbeing of men could emphasize the sustainable management of fish populations. Including both men and women in ES assessments and valuations also ensures that all services that play a key role for ensuring local livelihoods and community wellbeing are considered. ES conservation and valuation efforts (related to SDG 15) have a policy mandate to ensure gender equity (related to SDG 5), and it is crucial to work towards achieving both goals synergistically. Non-gender sensitive processes, in contrast, may result in prioritization or conservation objectives that do not include men’s or women’s perspectives, which in turn may impact ES management, communities’ livelihoods, and the sustenance of the provision of services into the future.

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Men's and women's frequency of mention across focus groups (count), highest and lowest value (max and min), median and mode for each criteria of importance group per ecosystem service type (from six focus groups conducted with men and six with women, with a total of 61 participants).

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Appendix 1 (continued)

Land for agricultural fields													
Men							Women						
Count	Max	Min	Median	Mode	Count	Max	Count	Max	Min	Median	Mode	Count	Max
Ecology	1	7	7	7									
Enjoyment					2	8				8		2	10
Food	6	10	7	10	10	10	6	10	6	10	10	3	10
Health	4	10	4	8.5			5	10	2	9	9	5	7
Hospitality	1	10	10	10									
Household economy	5	10	0	6.5	0	10	6	10	0	6.5	6	3	10
Transport													
Variety					3	10	3	10	8	10	10	2	10
Wellbeing	2	10	5	10	10	10	1	10	10	10			4
Number of criteria	11				9							9	
Materials for cultural activities													
Men							Women						
Count	Max	Min	Median	Mode	Count	Max	Count	Max	Min	Median	Mode	Count	Max
Abundance													
Accessibility					1	8	3	9	5	9	9	2	9
Availability	1	10	10	10	1	5	4	10	5	10	10	1	6
Construction							3	8	0	0	0	1	10
Cultural importance	1	10	10	10	2	10	4	10	6	10	10	1	10
Ecology													
Enjoyment					2	10							
Food	1	4	4	4			2	7	5	6		2	10
Health	1	10	10	10	2	5						2	9
Hospitality													
Household economy	1	7	7	7	3	8	3	9	3	7.5	9	3	6
Transport													
Variety					2	4	4	4	4	4	4	1	10
Wellbeing					1	2	2	9	2	5.5			10
Number of criteria	5				8		7					8	
Medicinal plants													
Men							Women						
Count	Max	Min	Median	Mode	Count	Max	Count	Max	Min	Median	Mode	Count	Max
Abundance	1	10	10	10									
Accessibility	4	9	4	8									
Availability	5	10	7	10	9								
Construction					10		1	10	10	10		1	10
Cultural importance	4	10	5	10	10							1	7
Ecology													
Enjoyment													
Food	2	4	3	3.5								1	6
Health	3	10	10	10	10							1	7
Hospitality	1	2	2	2									
Household economy	2	10	1	1	1							1	3
Transport													
Variety												1	7
												1	10

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Appendix 1 (continued)

Medicinal plants														Oxygen													
Men							Women							Men							Women						
	Count	Max	Min	Median	Mode		Count	Max	Min	Median	Mode	Count	Max	Min	Median	Mode	Count	Max	Min	Median	Mode						
Wellbeing	1	10	10	10	10		1	9	9	9		2					1	10	10	10							
Number of criteria	9						11										9										
Products from agricultural fields																											
Men							Women							Men							Women						
	Count	Max	Min	Median	Mode		Count	Max	Min	Median	Mode	Count	Max	Min	Median	Mode	Count	Max	Min	Median	Mode						
Abundance	2	10	10	10	10		1	9	8	8.5		1	4	2	3		1	10	10	10							
Accessibility	3	10	10	10	10		1	10	10	10		1	7	7	7		1	10	10	10							
Availability																											
Construction																											
Cultural importance	2	10	10	10	10							1	9	9	9		1	10	10	10							
Ecology												1	6	6	6												
Enjoyment																											
Food	2	10	10	10	10		2	10	10	10		1	8	8	8		1	10	10	10							
Health	2	10	4	7			1	10	10	10							1	5	5	5							
Hospitality	1	10	10	10																							
Household economy	2	6	5	5	5		2	7	5	5		1	10	9	9.5		1	3	3	3							
Transport																											
Variety																											
Wellbeing																											
Number of criteria	7						5					6					6										
Soil types																											
Water											Wild fruits																
Men						Women					Men					Women											
	Count	Max	Min	Median	Mode	Count	Max	Min	Median	Mode	Count	Max	Min	Median	Mode	Count	Max	Min	Median	Mode							
Abundance						3	10	4	8.5		1	9	9	9		4	10	5	8.5								
Accessibility						4	10	5	10		10					5	10	5	5.5								
Availability						1	2	2	2		2	1	7	7	7	3	4	3	4								
Construction	1	4	4	4		4	9	8	8		8	3	10	3	9	5	10	5	8								
Cultural importance	1	7	7	7												1	2	2	2								
Ecology											2	10	5	7.5													
Enjoyment	1	6	6	6							3	10	7	10	10	5	8	2	7								
Food	1	10	10	10		4	10	4	8.5		10					10	8	2	3								
Health	1	7	7	7		3	8	5	7.5		8	3	9	8	8	3	8	2	3								
Hospitality																											
Household economy	1	4	4	4							3	5	0	3		4	10	1	5								
Transport	1	2	2	2							1	9	9	9													
Variety	1	10	10	10							3	10	2	10	10												
Wellbeing	1	8	8	8		2	10	10	10		10					2	8	6	7								
Number of criteria	9					7					10					9											

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